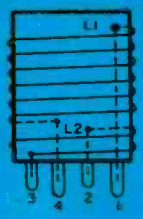
The novice cw transmitter with the crystal and coil for 80 meters plugged in. It is ready to go when the antenna is connected.

Build



BOTTOM VIEW OF COIL FORM

COIL TABLE

80 meters: L_1—28 turns No. 22 enameled wire close-wound on 1-inch diameter 4-pin form
L_2—5 turns No. 22 enameled wire closewound 1/8 inch from ground end of L_1

40 meters: L_1—15 turns No. 22 enameled wire close-wound on 1-inch diameter 4-pin form
L_2—4 turns No. 22 enameled wire closewound 3/16 inch from ground end of L_1

Use any conventional 4-pin, 1" dia. form. Winding spacing is measured between lower edge of L_2 and upper edge of L_1.

Before winding the coils, drill holes through form to pass ends of windings. Space holes to allow for width of each winding and distance between windings.

Remove enamel for about half an inch from end of wire. Pass wire through proper hole in side of form and corresponding base pin. Solder wire to pin. Wind required number of turns around form, keeping wire taut and leaving no space between turns. Cut off wire, leaving a few inches to work with. Pass end through proper hole in form. Remove enamel from end of wire and pass it through pin in base. Carefully pull wire taut, then solder end of wire to pin. Use coil cement over windings to prevent loosening.

Note that two different coils must be built to cover both the 40 and 80 meter bands.

this Novice CW Transmitter

By RUFUS P. TURNER

THE beginner in ham radio with a novice license should become active as quickly as possible with a low-powered telegraph (cw) transmitter. Operating this rig as often as he can will give valuable on-the-air experience in handling the code and in correct operating procedure. The best way to learn is by doing.

A novice's first transmitter should be both simple and inexpensive. A good idea is to use the lower frequency bands. There, the new operator usually will find more "rag-chewers" and local contacts than on the higher frequency long-distance bands. In the 80-meter band, novice c w operation is permitted between 3700 and 3750 kc. In the 40-meter band, the novice's territory is 7175 to 7200 kc. Crystal control *must* be used.

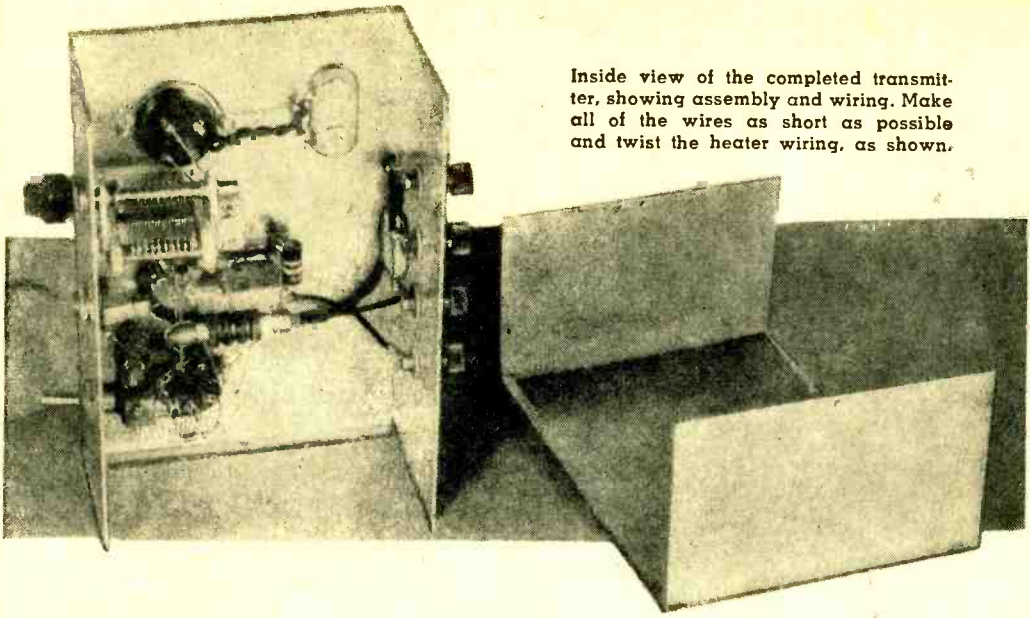
The transmitter shown here was made especially for beginners. While it is low-powered, it will give a good account of itself when operated with a good antenna. It does not take up much room, since it is built on an aluminum radio chassis box (*Bender* Type 145) 7" long, 5" wide, and 3" high.

To reduce expense and to keep hum-producing power equipment off the transmitter chassis, no power supply is built into the transmitter. This allows the experimenter to use any external unit supplying 250 volts d.c. at 50 to 65 ma. and 6.3 volts a.c. or d.c. at 1 ampere. Most experimenters keep a small power supply of this type on hand for general use. Such units also can be bought cheaply in surplus. The necessary a.c. and d.c. voltages often can be drawn from the receiver used with the transmitter. For portable use, a 6-volt storage battery can be used in conjunction with 180 to 225 volts of "B" batteries or a vibrator-type 250-volt supply.

Transmitter Circuit

The schematic diagram shows the circuit of the transmitter. A 6AQ5 tube (V_1) is used in a crystal oscillator circuit. This particular circuit keys quite well.

A shunt-fed plate circuit is employed. That is, the output (tank) circuit, consisting of coil L_1 and tuning capacitor C_7, is isolated from the d.c. plate voltage of the tube by capacitor C_6. This arrangement keeps d.c. voltage off the coil and protects the operator from electric shock. Nevertheless, switch S_1 should be thrown to its "off" position before changing coils, since



Inside view of the completed transmitter, showing assembly and wiring. Make all of the wires as short as possible and twist the heater wiring, as shown.

the r.f. voltage may burn the fingers quite painfully just the same.

The key is plugged into jack J_1. The two "Antenna" binding post terminals are connected to the antenna.

Construction

An 8-pin octal tube socket is mounted on the left end of the chassis to hold the crystal. Socket pins 1 and 4 receive the pins of the crystal holder, while other pins of this socket are used as tie points for resistor R_1, capacitors C_1 and C_2, and leads. A 1⅛" hole is needed for the crystal socket.

A 7-pin miniature tube socket for V_1 is mounted in a ⅝"-diameter hole near the center. At the right-hand end of the chassis, a 4-pin tube socket is mounted in a 1⅛" hole to hold the plug-in coil.

Directly behind this coil socket is the insulated 2-terminal binding post block for antenna connections. This block assembly is a *National* Type FWH. The insulating blocks fit into ½"-diameter holes drilled ¾" apart on centers.

Switch S_1, jack J_1, and tuning capacitor C_7 are mounted, from left to right, without insulation, along the front lip of the chassis. The jack and tuning capacitor require ⅜" mounting holes. The toggle switch (S_1) requires a ½" hole. Four insulated binding posts are mounted along the rear lip of the chassis for connections to 6.3 volts and 250 volts.

The two coils are wound on conventional 1"-diameter, 4-pin, phenolic plug-in forms. The accompanying coil table gives instructions for winding these coils. Each consists of a main coil L_1 and a coupling coil L_2. The ends of L_1 are fed into the two large pins of the form and soldered. The ends of L_2 are fed into the two small pins and soldered.

For adjusting the transmitter, make a test lamp by forming a 1¼"-diameter loop of insulated hookup wire and soldering its two ends to the terminals of a 6-volt pilot lamp.

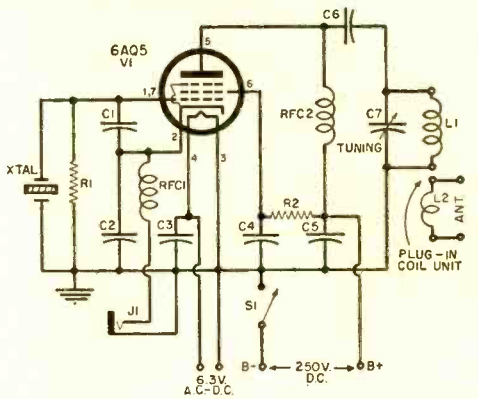
Obtain an 80-meter crystal on any frequency between 3700 and 3750 kc. and a 40-meter crystal on any frequency between 7175 and 7200 kc. Several crystals in each frequency range will allow movement "around the band" when interference sets in.

The simplest antenna to use with this transmitter is the center-fed type (cut for 40 or 80 meters) with coaxial or low-impedance ribbon feeder. Antenna dimensions and building instructions may be found in any amateur handbook. Other types of antennas may require a coupling coil and tuning capacitor external to the transmitter.

Operating Instructions

To place the transmitter into operation: (a) Plug in an 80-meter crystal. (b) Plug in the 80-meter coil. (c) Connect the 6.3 v and 250 v. power supply. (d) Throw the switch S_1 to "on." (e) When the tube has heated, plug the key into jack J_1. (f) Hold the loop of the test lamp over the top of the coil. (g) Depress the key; while holding it, adjust tuning capacitor C_7 until the lamp lights. Back away with the lamp if it is burning too brightly. (h) Tune capaci-

R_1—100,000 ohm, ½ w. carbon res.
R_2—33,000 ohm, 2 w. carbon res.
C_1—10 μμfd. mica capacitor
C_2—150 μμfd. mica capacitor
C_3, C_4, C_5—.005 μfd. mica capacitor
C_6—100 μμfd. mica capacitor
C_7—140 μμfd. midget variable capacitor (Hammarlund MC-140-S)
J_1—Midget open-circuit phone jack
L_1-L_2—Plug-in coil unit (See Coil Table)
RFC_1, RFC_2—2½-mhy. r.f. choke (National R100)
S_1—S.p.s.t. toggle switch
Xtal—Quartz crystal, 3700-3750 kc. or 7175-7200 kc.
V_1—6AQ5 tube
Other parts you will need: One aluminum chassis, 7" x 5" x 3" (Bender Type 145); one knob with pointer; one 8-pin octal socket; one 7-pin miniature socket; one 4-pin socket; two 4-pin plug-in coil forms; four binding posts; one double binding post assembly; screws, nuts, wire, and solder



Note: One side of the tube heater and B— are connected together. To avoid bypassing S_1 or shorting the heater supply, use a power supply which does not have B— connected to the heater circuit.

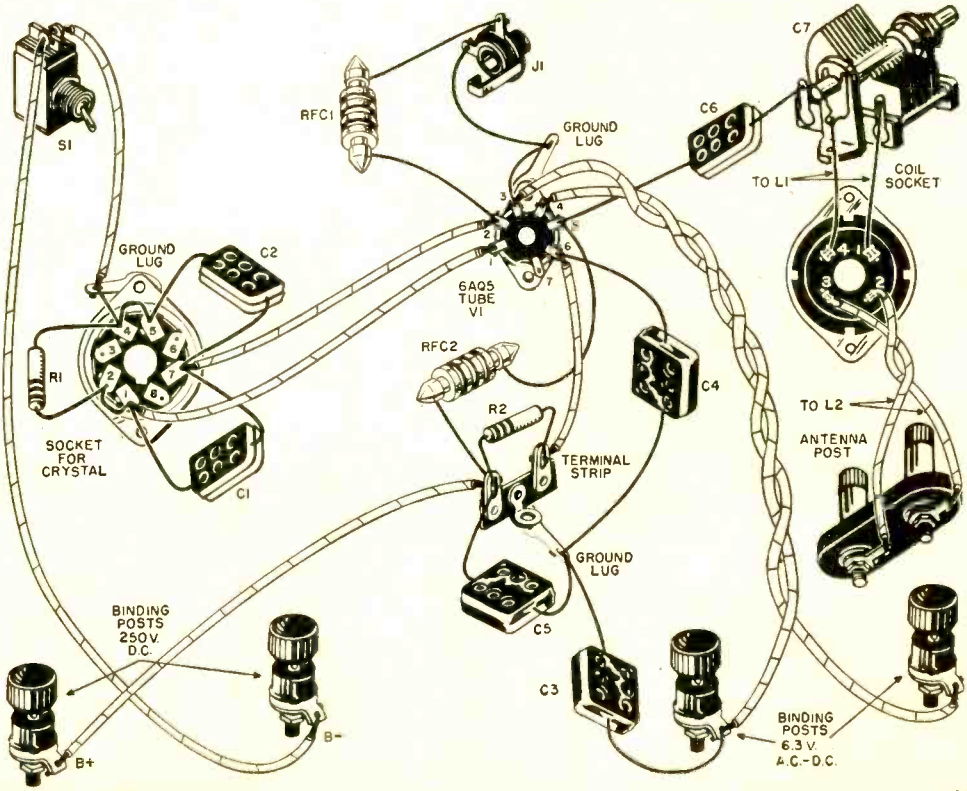
When wiring the transmitter follow both schematic and pictorial diagrams closely.

tor C_7 for brightest lamp response. (i) Taking care that the key is in its up or "off" position, connect the antenna leads to the "Antenna" binding posts. (j) Again, close the key, hold the lamp loop near the coil, and retune capacitor C_7 for brightest lamp response.

The transmitter now is tuned-up on 80 meters, and is ready to go. The signal may be monitored for smoothness by listening to it with a receiver (minus antenna) or on a c w monitor.

To tune up on 40 meters, repeat the entire process with a 40-meter crystal and the 40-meter coil plugged in.

If you do not have any of the power sources mentioned in the early part of this article, you can use this transmitter with a power supply to be described in the next issue of POPULAR ELECTRONICS. END



Electronic TUBES

6AQ5—5AQ5

BEAM PENTODE

DESCRIPTION AND RATING

The 6AQ5 is a miniature beam-power pentode designed for use in the audio-frequency power output stage of television and radio receivers. It may also be used as a triode-connected vertical deflection amplifier in television receivers. Within its maximum ratings, the performance of the 6AQ5 is equivalent to that of the 6V6-GT.

Except for heater ratings, the 5AQ5 is identical to the 6AQ5. In addition, the 5AQ5, as a result of its controlled heater warm-up characteristic, is especially suited for use in television receivers which employ series-connected heaters. When the 5AQ5 is used in conjunction with other 600-milliampere types which exhibit essentially the same heater warm-up characteristic, heater voltage surges across the individual tubes are minimized during the warm-up period.

GENERAL

ELECTRICAL

	5AQ5	6AQ5	
Cathode—Coated Unipotential			
Heater Voltage, AC or DC	4.7	6.3	Volts
Heater Current	0.6	0.45	Ampere
Heater Warm-up Time*	11	....	Seconds
Direct Interelectrode Capacitances, approximate†			
Grid-Number 1 to Plate		0.4	μμf
Input		8.0	μμf
Output		8.5	μμf

MECHANICAL

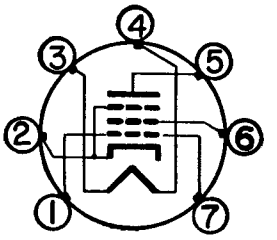
Mounting Position—Any
Envelope—T-5½, Glass
Base—E7-1, Miniature Button 7-Pin

MAXIMUM RATINGS

DESIGN-CENTER VALUES UNLESS OTHERWISE INDICATED

	Class A1 Amplifier	Vertical-Deflection Amplifier‡ (Triode Connection)§	
DC Plate Voltage	250	250	Volts
Peak Positive Pulse Plate Voltage		1100π	Volts
Screen Voltage	250	...	Volts
Peak Negative Grid-Number 1 Voltage		250	Volts
Plate Dissipation	12	9.0▲	Watts
Screen Dissipation	2.0	...	Watts
DC Cathode Current		35	Milliamperes
Peak Cathode Current		105	Milliamperes
Heater-Cathode Voltage			
Heater Positive with Respect to Cathode			
DC Component	100	100	Volts
Total DC and Peak	200	200	Volts
Heater Negative with Respect to Cathode			
Total DC and Peak	200	200	Volts
Grid-Number 1 Circuit Resistance			
With Fixed Bias	0.1	...	Megohms
With Cathode Bias	0.5	2.2	Megohms
Bulb Temperature at Hottest Point	250	250	C

BASING DIAGRAM

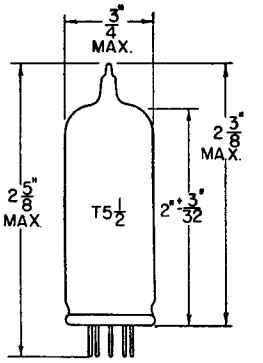


RETMA 7BZ

TERMINAL CONNECTIONS

Pin 1—Grid-Number 1
Pin 2—Cathode and Beam Plates
Pin 3—Heater
Pin 4—Heater
Pin 5—Plate
Pin 6—Grid-Number 2 (Screen)
Pin 7—Grid-Number 1

PHYSICAL DIMENSIONS



RETMA 5-3

GENERAL ELECTRIC

Supersedes ET-T271D dated 6-53

CLASS A_1 AMPLIFIER

Plate Voltage	180	250	Volts
Screen Voltage	180	250	Volts
Grid-Number 1 Voltage	−8.5	−12.5	Volts
Peak AF Grid-Number 1 Voltage	8.5	12.5	Volts
Plate Resistance, approximate	58000	52000	Ohms
Transconductance	3700	4100	Micromhos
Zero-Signal Plate Current	29	45	Milliamperes
Maximum-Signal Plate Current	30	47	Milliamperes
Zero-Signal Screen Current	3.0	4.5	Milliamperes
Maximum-Signal Screen Current	4.0	7.0	Milliamperes
Load Resistance	5500	5000	Ohms
Total Harmonic Distortion, approximate	8	8	Percent
Maximum-Signal Power Output	2.0	4.5	Watts

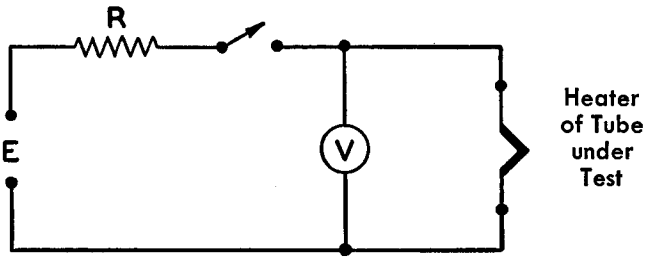
PUSH-PULL CLASS AB_1 AMPLIFIER, VALUES FOR TWO TUBES

Plate Voltage	250	Volts
Screen Voltage	250	Volts
Grid-Number 1 Voltage	−15	Volts
Peak AF Grid-to-Grid Voltage	30	Volts
Zero-Signal Plate Current	70	Milliamperes
Maximum-Signal Plate Current	79	Milliamperes
Zero-Signal Screen Current	5.0	Milliamperes
Maximum-Signal Screen Current	13	Milliamperes
Effective Load Resistance, Plate-to-Plate	10000	Ohms
Total Harmonic Distortion	5	Percent
Maximum-Signal Power Output	10	Watts

AVERAGE CHARACTERISTICS, TRIODE CONNECTION§

Plate Voltage	250	Volts
Grid-Number 1 Voltage	−12.5	Volts
Amplification Factor	9.5	
Plate Resistance, approximate	1970	Ohms
Transconductance	4800	Micromhos
Plate Current	49.5	Milliamperes
Grid-Number 1 Voltage, approximate I_b = 0.5 Milliampere	−37	Volts

* Heater warm-up time is defined as the time required in the circuit shown at the right for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1). For this type, E = 18.7 volts (RMS or DC), V_1 = 3.73 volts (RMS or DC), and R = 23.5 ohms.

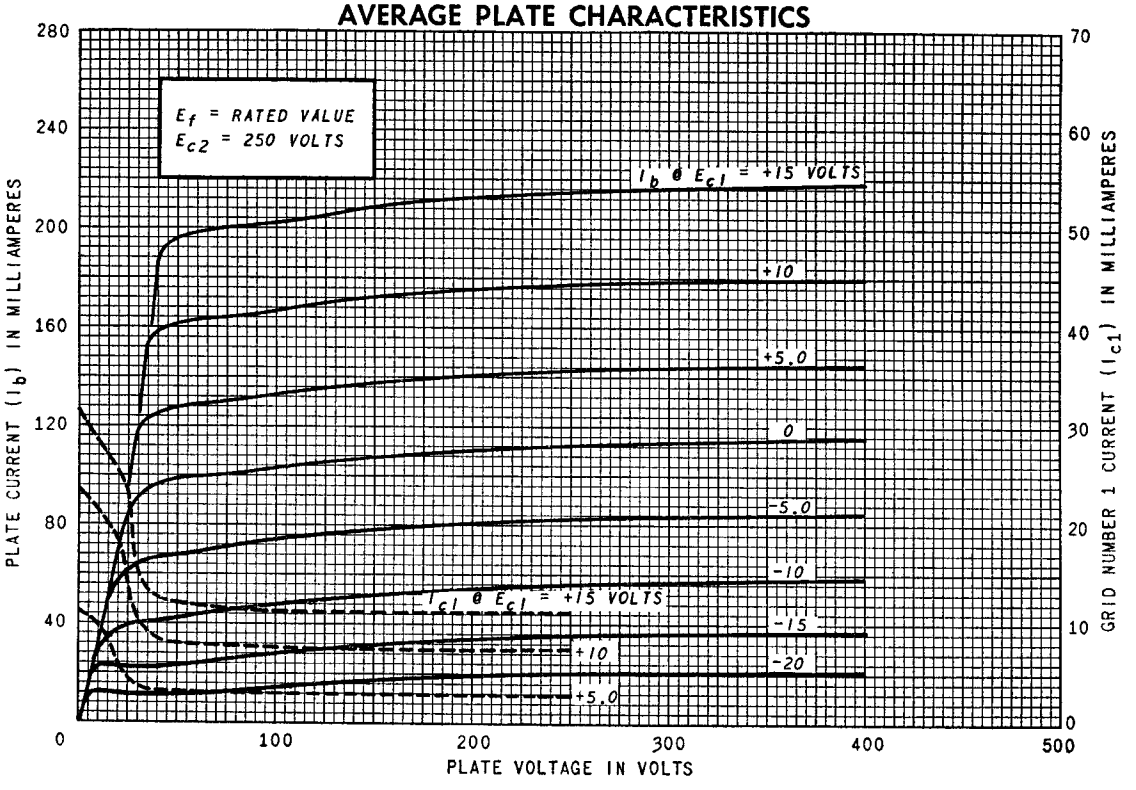


† Without external shield.
‡ For operation in a 525-line, 30-frame television system as described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations," Federal Communications Commission. The duty cycle of the voltage pulse must not exceed 15 percent of one scanning cycle.
§ With screen tied to plate.

π Value given is to be considered as an Absolute Maximum Rating. In this case, the combined effect of supply voltage variation, manufacturing variation including components in the equipment, and adjustment of equipment controls should not cause the rated value to be exceeded.

▲ In stages operating with grid-leak bias, an adequate cathode-bias resistor or other suitable means is required to protect the tube in the absence of excitation.

AVERAGE PLATE CHARACTERISTICS



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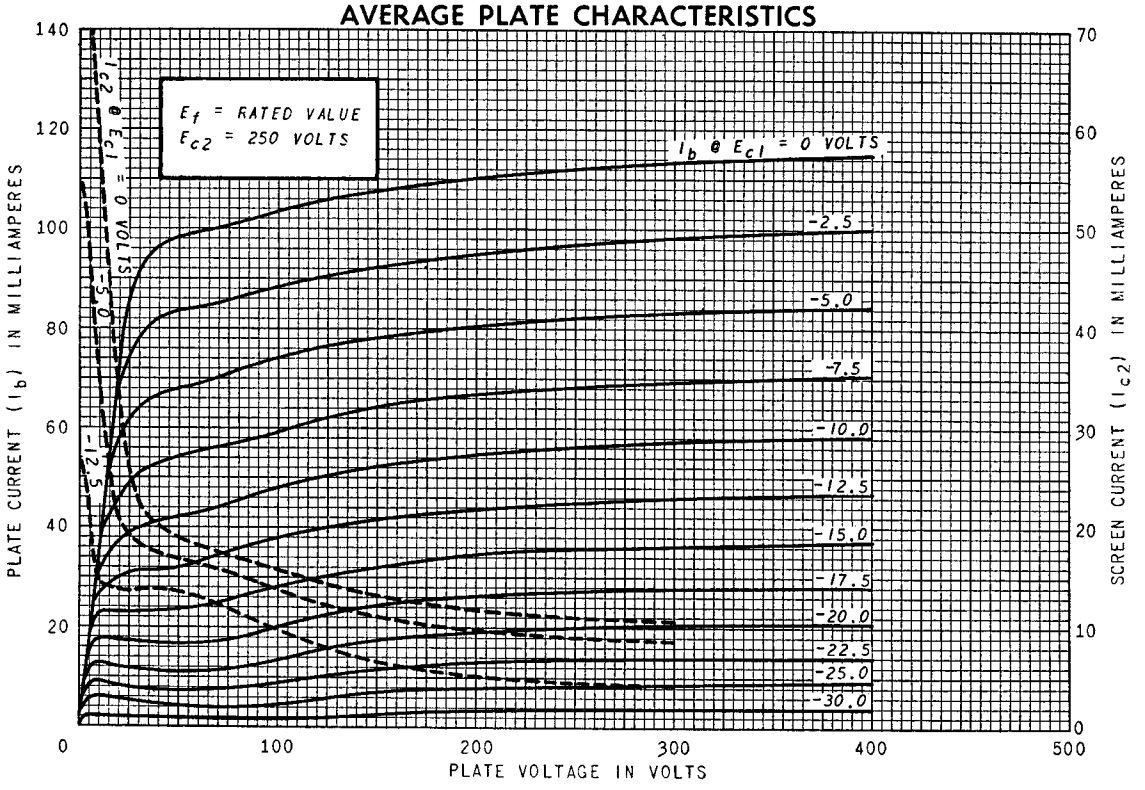
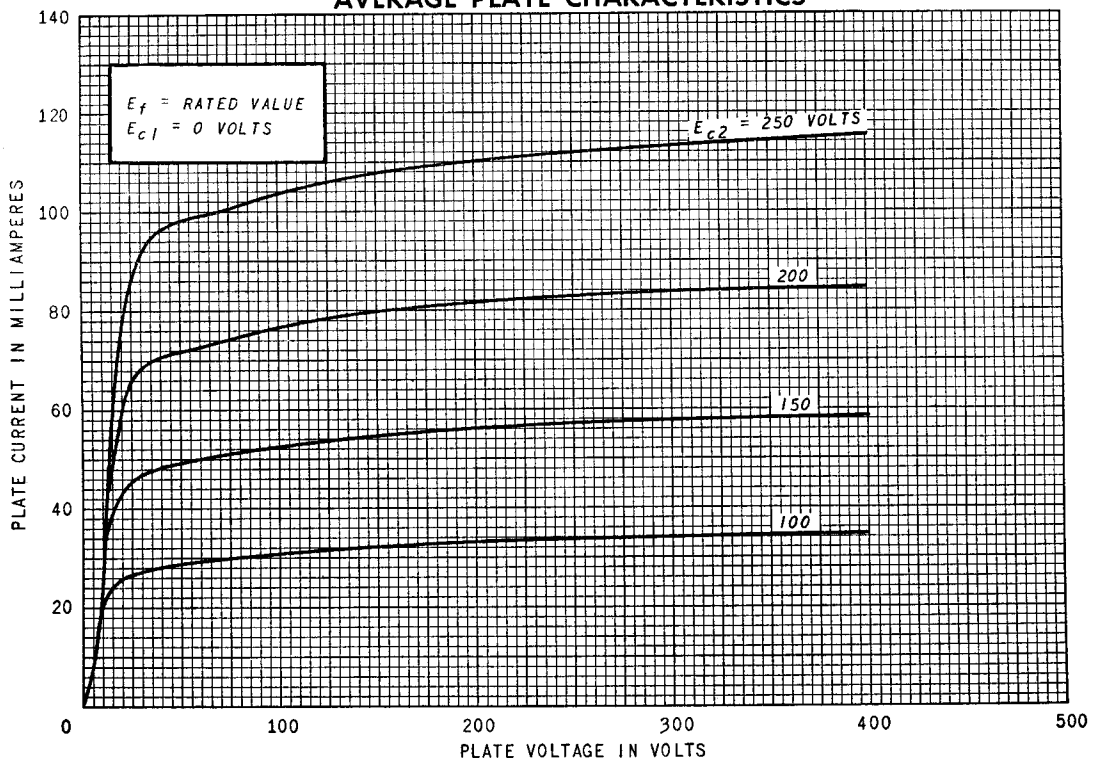
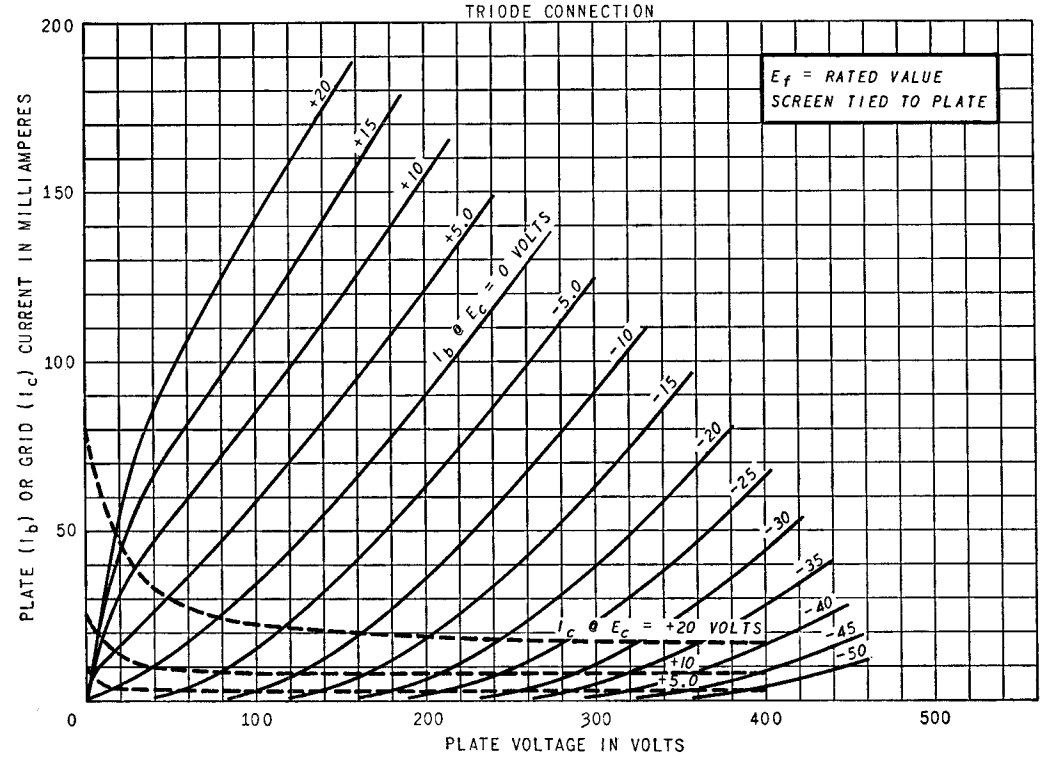


AVERAGE PLATE CHARACTERISTICS

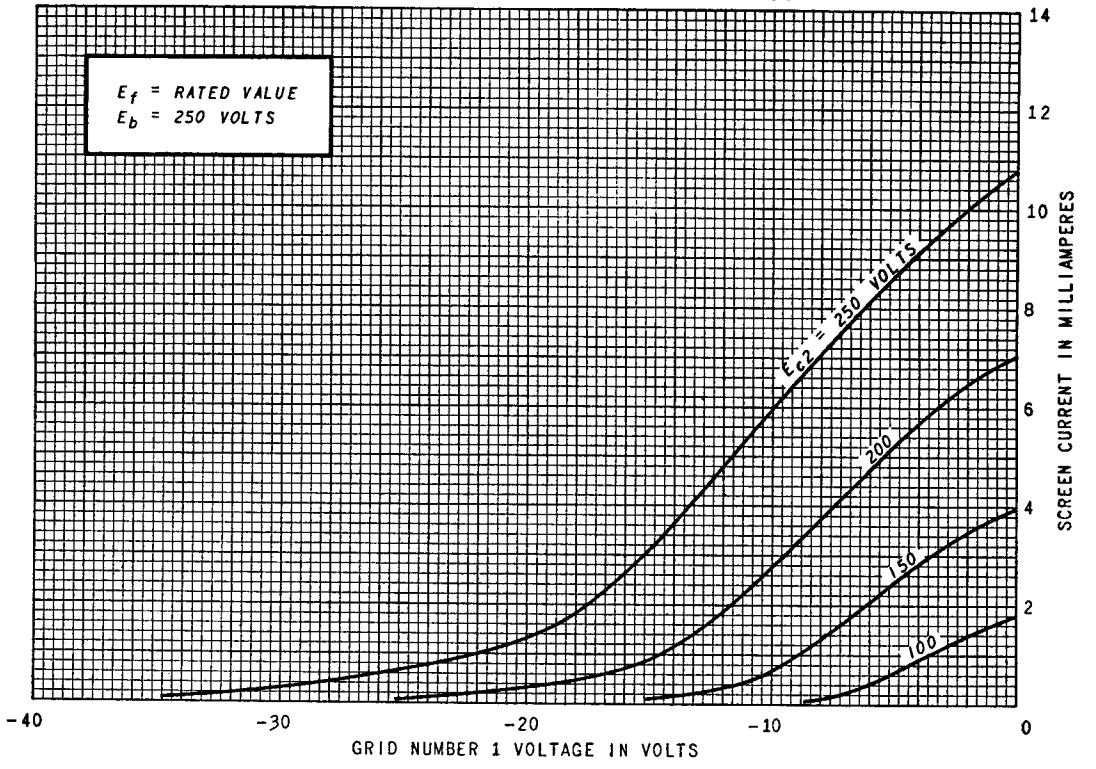


AVERAGE PLATE CHARACTERISTICS

TRIODE CONNECTION



AVERAGE TRANSFER CHARACTERISTICS



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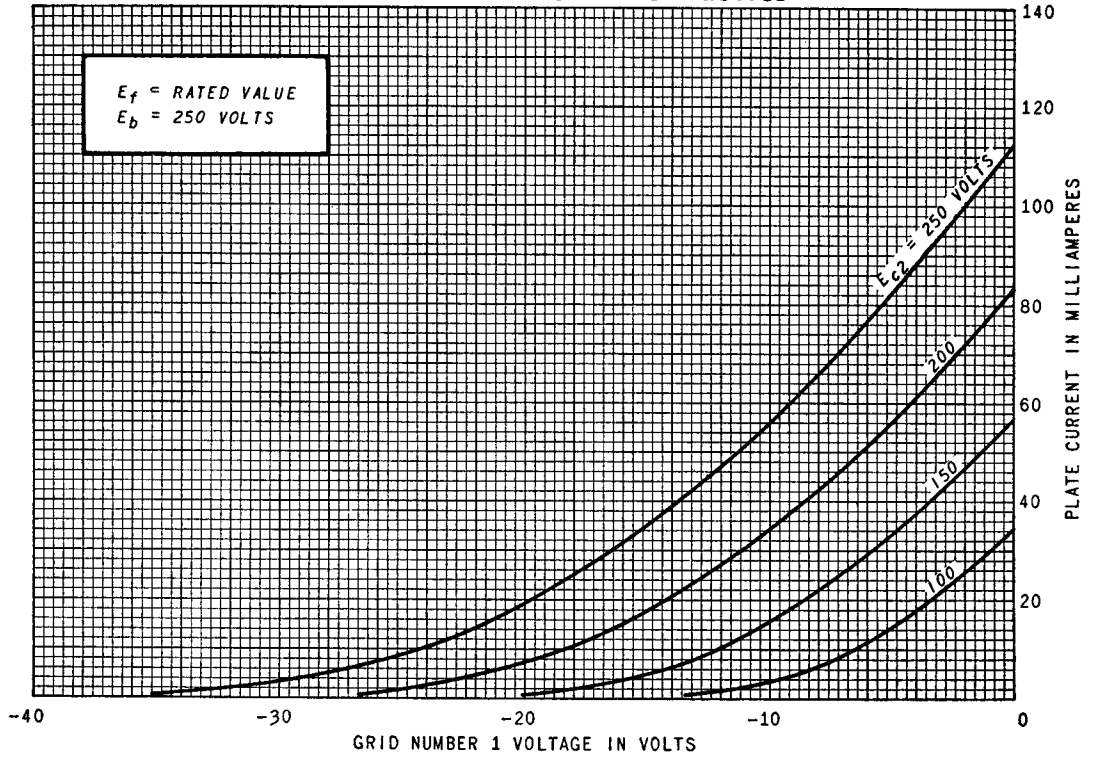
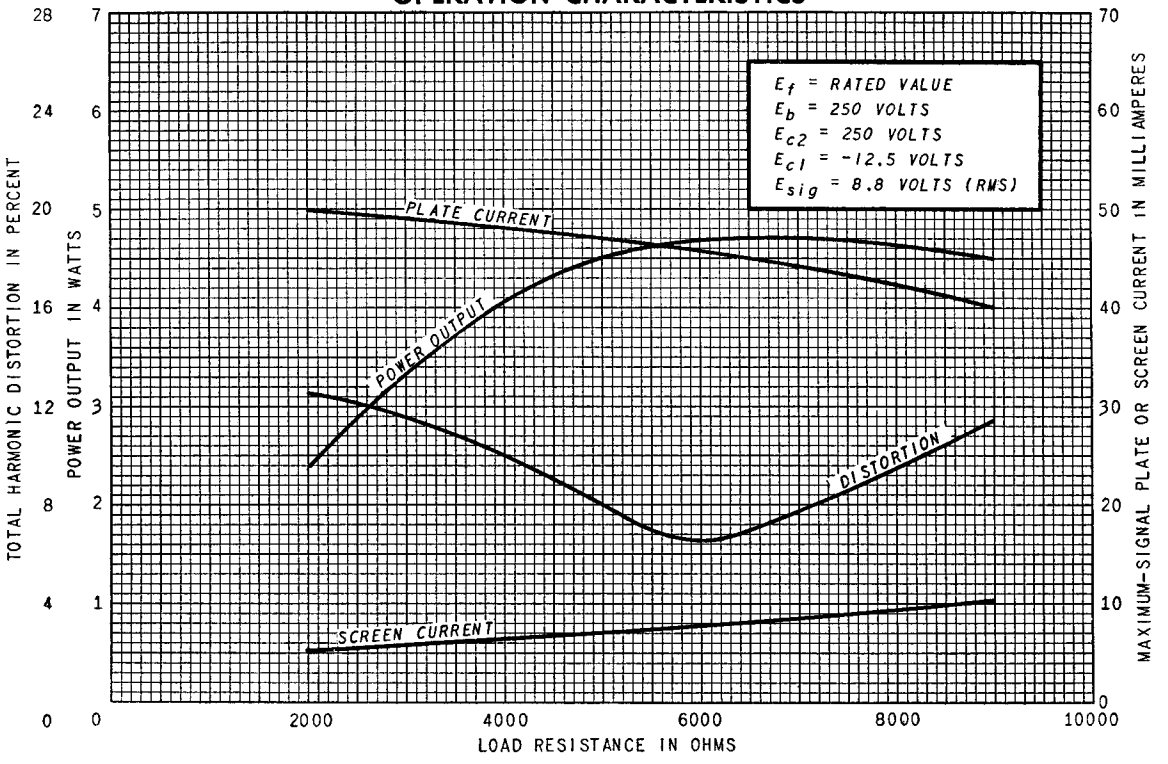


OPERATION CHARACTERISTICS



TUBE DEPARTMENT

GENERAL ELECTRIC

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